

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

151st Session (1938-9)

Part 1

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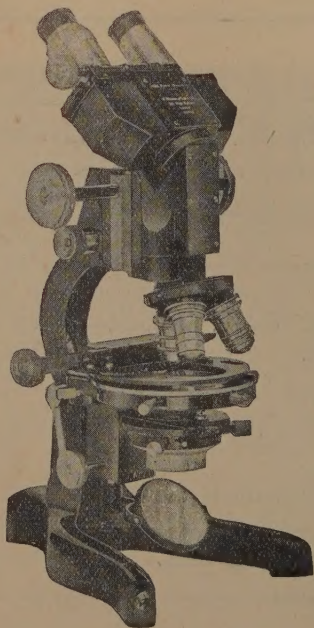
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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

151st Session (1938-9)

Part 1

PROCEEDINGS OF THE GENERAL MEETING 27 October 1938

Mr. J. RAMSBOTTOM, O.B.E., M.A., Dr.Sc., President,
in the Chair

The President welcomed Professor Maurice Caullery, F.M.L.S., who was present.

The Proceedings of the statutory Anniversary Meeting held on Thursday, 24 May 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Winifred Margaret Warden.

Certificates of recommendation of the following candidates for Fellowship were read :—For the first time, in favour of The Rt. Rev. Arthur Cayley Headlam, Bishop of Gloucester, Thomas Alan Oxley, Sidney Robert Brown Pask, Tom Stansfield, Royden Samuel Wale, Margaret Halley Chambers, Bruce Pollard-Urquhart, Arthur John Carpenter, Robert Roderick Broome, Raman Kesavan Nair, Patroclos Demetrios Critopoulos, and Elsa Landby.

The President reported the deaths of the following members :—R. H. Beamish, Bernard Dearman Burt, C. F. M. Swynnerton, Gilbert Christy, Robert S. Hole, C.I.E., Rev. Henry Bride Barber, L. J. K. Brace, R. F. Notcutt, and A. W. Sheppard, Fellows of the Society ; Dr. A. Zahlbruckner and Prof. C. Raunkiaer, Foreign Members ; and referred to the late Mr. Sheppard's voluntary work for the Library.

The President expressed the thanks of the Society to the many Fellows and to the Staff of the Society for their services in connection with the 150th Anniversary Celebrations.

The following Resolutions were read, put to the Meeting, and carried with acclamation :—

The Fellows of The Linnean Society of London in General Meeting assembled take this, their first opportunity, of sending their warmest thanks to all Societies, Academies and individuals who have honoured the Society with congratulations on the occasion of its 150th Anniversary ; as well as to those institutions and individuals who helped in any way to make the Celebrations a success.

The Fellows of The Linnean Society of London in General Meeting assembled desire to put on record their warmest thanks to Mr. FRANCIS DRUCE, Treasurer and Vice-President, for his generosity in meeting by a donation of £197 10s. the expenses of the 150th Anniversary Celebrations.

The Fellows of The Linnean Society of London in General Meeting assembled desire to express to Lt.-Col. A. T. GAGE, C.I.E., LL.D., F.L.S., their high appreciation of his History of the Society, and to render their thanks to him for this conspicuous service.

The President gave an account of the action taken during the recent international crisis to safeguard the Linnaean Collections by carrying them out of London, and stated that an emergency fund was opened to meet the cost of packing and, had it ultimately proved necessary, removing them, to which Fellows were asked to contribute. The fund is still open. The following Resolution was put to the Meeting and carried with acclamation :—

The Fellows of The Linnean Society of London in General Meeting assembled desire to express their thanks to HIS GRACE THE DUKE OF BEDFORD, K.G., F.R.S., F.L.S., for his readiness to house the Linnaean Collections at Woburn Abbey in the event of war.

Miss M. CARLETON, Ph.D., gave an account of her paper, 'The biology of *Pontania proxima* Lep., the Bean Gall Sawfly of Willows'. (Communicated by Mr. R. B. BENSON, M.A., F.L.S.) [The paper will be published in full in the Journal, Zoology.]

Abstract.—

Pontania proxima Lep., the Bean Gall Sawfly of willows, is a common gall-forming sawfly, the general outline of whose life-history has been known since the 18th century.

It is recorded from almost every country in Europe and from western Asia.

The life-history of the sawfly was described in detail. The egg swells during incubation, as is usual among Tenthredinidae, and hatching occurs in 12–19 days, when the gall has reached its maximum size. There are five larval instars, which last about 15 days. The larva makes a small round aperture in the wall of the gall at some time during its life, generally in the fourth instar. The constant position of the aperture at one end of the gall and its possible functions were discussed. The prepupal stadium is passed inside a cocoon. It lasts for 7–18 days in the first brood. In the second brood it may last for 7–18 days or for some months. In the latter event the sawfly hibernates as a prepupa. This condition obtains in a normal winter in SW. England, but when the weather is exceptionally warm, a large proportion of the sawflies pupate and emerge in the autumn, a natural control on their numbers being thus exercised, since they are unable to find young willow leaves for oviposition. The species is parthenogenetic and the male is extremely rare.

Sawflies were bred on two species of willows, *Salix triandra* Linn. and *Salix fragilis* Linn. The question of biological races within the species was discussed. There are apparently no morphological differences. Certain differences were observed in times of emergence of the sawfly on the two host plants. Experiments in which the female sawfly was offered for oviposition a species of willow which it would not normally choose, showed that eggs were laid with extreme reluctance. The galls did not develop normally, the larvae generally died, and the small proportion of adults which eventually emerged were undersized weaklings, all of which died without laying eggs.

A large number of Hymenopterous parasites have been recorded from *P. proxima*. Of special interest is the very common Ichneumonid endoparasite, *Angitia vestigialis* Ratz., which in one case was found to attack as many as 37 per cent. of the hosts. The ectoparasitic Ichneumon, *Pimpla vesicaria* Ratz., parasitized from 1 to 7 per cent. of the sawflies. Six other species of parasites were bred during this investigation, one, *Scopimenus pygobarbus* Rom., being a new genus and species. An inquiline, *Balanobius salicivorus* Payk., is of common occurrence in the galls and its life-history was described. Its numbers fluctuate enormously in different localities and seasons, varying from being present in 40 per

cent. of the galls to being totally absent. It has a common endoparasite, *Thersilochus flavicornis* Thoms., and is occasionally attacked by the ectoparasites normally found on *P. proxima*. Various casual inhabitants of the galls were mentioned. They obtain either food or protection or both from the gall, but are not intimately connected with the biology of the sawfly.

Discussion.—

Prof. E. W. MACBRIDE congratulated Dr. Carleton most heartily on her paper on the life-history of *Pontania proxima*. She had made a most important contribution to knowledge. He was reminded of the work of Prof. J. Heslop Harrison, F.R.S., on the same subject, which was regarded as one of the classical researches proving the truth of the Lamarckian theory of heredity evolution. Prof. Harrison had shown that, although *Pontania* is so adapted to the particular variety of willow on which it has been bred, if it is forced to lay on a closely allied variety it produces very few galls. A few of these come to maturity. Nevertheless, if the insects from these are collected and bred, in five years they become so adapted to the new variety that if they are given the choice of returning to the original variety they refuse to do so. Dr. Carleton has also found that if *Pontania* be transferred to a new species it produces very few galls, very few of which ripen. If she will continue her experiments and save the very few specimens yielded by the few galls on the new species and rear them for four or five years she will provide most valuable confirmation for Prof. Harrison's work.

Mr. ROBERT B. BENSON said he thought the Society was much indebted to Miss Carleton for giving such an interesting and lucid account of her work, which he considered to be important for two main reasons:—

Firstly, she had shown that within the species-complex known as *Pontania proxima* Lep., there appeared to be well-defined food-plant races (comparable with those found by Prof. J. W. Heslop Harrison in the allied species *P. viminalis* Linn.), but he would like to see how the two races dealt with would respond if they were offered willows hybrid between *Salix fragilis* Linn. and *S. triandra* Linn. After examining long series of the adult insects bred by Miss Carleton and now presented to the British Museum, he had been unable to separate adults of the two races on any morphological characters, but that, when comparing them with representatives of races bred by himself from willows of the *S. Caprea* Linn. group, he had detected slight, but apparently constant, morphological differences in the form of the saw-sheath. Whatever taxonomic status were given to these two sets of races, they appeared at any rate to represent incipient species.

Secondly, Miss Carleton had shown us how much we had still to learn about some of our commonest insects. He believed that such studies as these should be the present aim of animal ecologists, because not until similar studies as these had been undertaken with all our common animals would we be in a position to embark on a scientific study of regional animal ecology.

Mr. HAROLD J. BURKILL (Visitor) stated that his experience of *Pontania proxima* Lep. was that when on *Salix triandra* the galls were more of a chocolate-brown colour and not the pinkish red that was characteristic of the galls on *S. fragilis*. He asked if Dr. Carleton had any opinion as to the galls on *S. Caprea* and *S. cinerea* which some authorities considered to be due to *P. proxima*, but as the appearance of the galls generally showed differences they appeared to be different species.

The PRESIDENT suggested that a study of the insect on hybrid willows might be particularly interesting.

Dr. CARLETON replied that she had not done any work on the galls of *S. Caprea* and *S. cinerea*. On *S. triandra* the gall is dark red above, pale yellowish green below, and the cuticle is glabrous and quite smooth. On *S. fragilis* the gall is bright rose-pink above and either pink or yellowish green below, and the cuticle is raised into many uneven little ridges and protuberances.

Mr. B. C. SHARMAN, B.Sc., gave an account of his paper 'The development of the sinker of *Orchis mascula* Linn.'. (Communicated by Prof. J. B. PRIESTLEY, D.S.O., B.Sc., F.L.S.)

[The paper will be published in the Journal, Botany.]

Abstract.—

Genera of the Ophrydeae (which includes *Habenaria*, *Ophrys*, *Orchis*, etc.) perennate by swollen underground structures, variously called tubercules, tubers, droppers, etc. It is suggested that the term sinker be used to cover the whole of the structure with its bud and attachment to the parent plant, and that the term tubercule be reserved for the swollen root portion containing the food reserve. The sinker varies in detail from species to species, but all are similar in that they consist of a much swollen root part associated with a bud which is attached to the parent plant by a hollow tube.

External morphology.—A plant of *Orchis mascula* Linn., dug up at the time of flowering in April to May, shows two ovoid, slightly pointed tubercules, one of which is shrunken, having been depleted by the flowering axis above, while the other is firmer, paler, and attached to the flowering plant by a short stalk of 0.5–2.5 cm. long. Above the shrunken

tubercule, at the base of the flowering axis, is a ring of dead tissue, above which are some 3-7 scale-leaves, followed by 5 or more assimilating leaves and the inflorescence.

Cutting through the attachment stalk proves it to be a hollow tube bearing a bud in the distal end where it joins the tubercule. It is attached to the parent axis through a split in the 3rd scale-leaf.

When the parent plant flowers and the assimilating leaves and inflorescence mature and die, the tube connecting the new tubercule to the parent plant disintegrates, being now represented as a small ring of dead tissue where the bud and the tubercule are united. The bud, originally at the end of the tube, continues to grow until it is about 2-3 cm. long, at which time (August) it already contains the primordia of next Spring's assimilating leaves, together with the inflorescence. Removal of the scale-leaves covering the bud shows that axillary buds are present in the axils of the 1st, 2nd, and 3rd scales. Externally, the bud remains in this condition until the following January or February, except for the production of a number of adventitious roots coming through the scales from the axis inside. Internally, as soon as these roots have grown out 2 or 3 cm., the axillary buds in scales 1, 2, and 3 show a small basal swelling, indicating that tuberization has occurred and that the root storage portion or tubercule has been initiated.

In early Spring, during January or February, the bud in the axil of scale 3 grows downwards, splitting the scale and carrying the incipient tubercule at the end of a tube into the soil. Dissection of plants at this stage shows that the adaxial side of the first leaf of the axillary bud remains attached to the parent plant. When growing in conditions of good aeration (e.g. in pots) the tube grows to a considerable length, 3-4 cm., carrying the tubercule and bud well down into the ground.

Developmental anatomy.—Commencing with a plant whose roots have not yet grown out, it is seen that each of the buds in the axils of the first, second, and third scales has a normal appearance, consisting of a conical apical meristem and two or three primordia. At this stage there are no roots associated with these buds, but from September onwards one root structure is found associated with each bud. The bud is now said to have tuberized. The root structure or future tubercule would seem to be in association with the rudimentary axillary axis—the coleorhiza covering it being regarded as part of this axis.

During the late Autumn or early Spring, the tubercule continues to develop a little, but the main activity is in the growth of the bases of the first two leaves of the bud, together

with part of the bud axis, forming a hollow tube which elongates and carries the rest of the bud together with the tubercule down into the soil, splitting through the subtending scale-leaf. When the tube has reached its final length, the tubercule at the end thickens rapidly with mucilage reserves. Normally it is only the bud in the axil of the third scale which produces a sinker, but removal of this bud causes that in the axil of scale 2 to develop.

Examination of a bud which has just tuberized shows that the first primordium has a single median strand which connects with strands in the parent axis and with a strand going to the tip of the tubercule. The strand of the first primordium also sends a small connexion towards the shoot meristem of the bud, presumably leading to a higher leaf.

When the sinker tube has reached its final development and has carried the bud and tubercule down into the ground, a complex vascular anatomy is observed, of which the following are the main features:—

(1) The first primordium has a single strand which sends one branch to the parent axis and another down the tube until the tubercule is reached, where it divides into a number of separate strands, most of which continue down in the tubercule as separate steles: one branch, however, goes towards the bud meristem.

(2) The single strand of the second leaf runs down the abaxial side of the tube until the tubercule is reached, where it branches, some strands going down into the tubercule, some to the bud meristem, while one crosses under the bud and continues up the tube on the adaxial side and then enters the parent axis.

(3) The adaxial side of the tube receives a number of strands directly from the parent axis—these for the most part run into and down the tubercule as separate steles.

(4) Strands from other primordia of the bud form a complex node, from which strands run down into the tubercule.

From the above developmental anatomy it would seem that the attachment tube is to be considered as being composed of:—(1) the base of the second bud-leaf, (2) a portion of the base of the first bud-leaf, and (3) some tissue apparently derived from the axis of the bud.

The tubercule consists of a groundwork of parenchyma interspersed with cells swollen with mucilage reserves. The numerous steles derived from the bud primordia and from the parent axis are each enclosed in an endodermis with Casparian strips. They divide and anastomose as they run down towards the tip, where, in a young tubercule, they are seen still differentiating out of a common meristem. In a fully developed tubercule they unite at the tip and are enclosed

in an endodermis, which is also continued round the distal end of the union.

From its point of origin and its original normal appearance, it would seem that the tubercule is to be regarded as being equivalent to a single root with a rather large meristem, from which are differentiated a number of separate steles separated by parenchyma and mucilage-cells.

Discussion.—

Miss L. I. SCOTT said that Mr. Sharman's investigation of the sinker of *Orchis mascula* seems to bring out three main points. First, that the sinker is largely foliar in nature, and is another illustration of the remarkable capacity for growth of the basal regions of Monocotyledon leaves. Secondly, the anatomical study has shown that the sinker-tube is also in part composed of the axial region of the sinker-bud; the vascular strand of the second leaf of the bud, distal to the parent axis, may be traced from the leaf, beneath the meristem of the bud, and up the side of the tube nearest the parent axis. Light has also been thrown upon the nature of the root portion or tubercule. In a normal axis, many roots may arise from a node, whilst in the case of the tubercule an equivalent vascular supply is associated with only a single large root initial. It does not seem surprising that in this large root initial, in which food storage is taking place, the bundles may remain separate and give rise to the 'polystelic' structure. That, in fact, only a single root initial is present is shown by the coalescence of the bundles into a single normal root-stele at the close of growth of the tubercule.

Mr. E. MILNE-REDHEAD, M.A., gave an account of the paper by himself and Dr. H. G. SCHWEICKERDT, F.L.S., 'A new conception of the genus *Ammocharis* Herb.'. [The paper will be published in the Journal, Botany.]

Abstract.—

In his subdivision of *Amaryllis* Linn., published in 1821, Herbert placed *Amaryllis coranica* Ker-Gawl. and *Amaryllis falcata* (Jacq.) L'Hérit. in a new genus, *Ammocharis*, separated, among other characters, by its leaves perishing in winter and the same bases growing out to form new blades in the spring. Investigation showed that *Amaryllis longifolia* Linn. is conspecific with *Ammocharis falcata* (Jacq.) Herb., and that the epithet *longifolia* has, for over a century, been misapplied to a species of *Crinum*. *A. longifolia*, which is a native of the Cape, was found to possess characters of flower and fruit so different from *A. coranica* that the authors place it in a new monotypic genus. Certain tropical African

species of *Crinum* were found to possess the same type of leaves and habit of growth as *Ammocharis*, and consequently *Crinum Tinneanum* Kotschy & Peyr. (including *C. ammocharoides* Baker, *C. Lastii* Baker, *C. Thruppii* Baker, *C. Bainesii* Baker, and *C. rhodanthum* Baker), *C. heterostylum* Bullock, *C. angolense* Baker (including *C. curvifolium* Baker), and *C. Baumii* Harms are transferred to *Ammocharis*. In addition the monotypic genus *Stenolirion* Baker is found to be conspecific with *Crinum Tinneanum* Kotschy & Peyr.

Discussion.—

Dr. T. A. SPRAGUE said that, having had an opportunity of observing the course of the investigation, he had been impressed by the thorough manner in which the authors had tackled the various problems connected with it. They had not rushed prematurely into publication, but had obtained data, photographs, and living plants from correspondents in Africa, in addition to examining a large amount of herbarium material. Nor had they neglected historical research. Had previous authors paid attention to Ker-Gawler's observations, published in 1812, much of the confusion regarding the identity of *Amaryllis longifolia* Linn. might have been avoided.

The following paper was read in title :—

'New South African Species of the Genus *Caeculus* (Acari).' By R. F. LAWRENCE, Ph.D., Natal Museum, Pietermaritzburg, South Africa. (Communicated by M. A. C. HINTON, F.R.S., Sec. L.S.) [This paper has been published in the Journal, Zoology, XL (No. 273).]

PROCEEDINGS OF THE GENERAL MEETING

10 November 1938

Mr. J. RAMSBOTTOM, O.B.E., M.A., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 27 October 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of The Rt. Rev. Arthur Cayley Headlam, Bishop of Gloucester, Thomas Alan Oxley, Sidney Robert Brown Pask, Tom Stansfield, Royden Samuel Wale, Margaret Halley Chambers, Bruce Pollard-Urquhart, Arthur John Carpenter, Robert Roderick Broome, Raman Kesavan Nair, Patroclos Demetrios Critopoulos, and Elsa Landby ; for the first time, in favour of Charles Russel Metcalfe.

The President reported the death of Miss Clotilde von Wyss, F.L.S.

The Botanical Secretary, on behalf of the author, Dr. B. MILLARD GRIFFITHS, gave an account of ' Early references to Waterbloom in British Lakes '. [Printed in full below.]

Mr. I. MACKENZIE LAMB, F.L.S., gave an account of his paper, ' A review of the genus *Neuropogon* (Nees & Flot.) Nyl., with special reference to the Antarctic species '. [This paper will be published in the Journal, Botany.]

Abstract.—

The writer began by emphasizing the importance of the chemical characteristics in the classification of lichens, and showed how certain lichen-acids belonging to the Depsidone-group form characteristically shaped crystals of their Potassium-salts when treated with potassium hydroxide under the microscope. The reagent Paraphenylenediamine, recently introduced by Asahina, produced coloured condensation-compounds with many lichen-acids, and the reactions could be observed on the thallus itself. With the aid of these chemical criteria he had (he said) succeeded in evolving a fairly natural classification of the genus *Neuropogon*. He then proceeded to deal with the geographical distribution of some of the species. *Neuropogon* is a predominantly Southern Hemisphere genus, but *N. sulphureus* is widely distributed in the Arctic circumpolar basin, and occurs again at high altitudes in the Andes of Ecuador and Peru, penetrating also far southwards into the Antarctic. *N. antarcticus* shows Antarctic circumpolar distribution. The phytogeographical repartition of several other species was also dealt with in some detail.

Discussion.—

The BOTANICAL SECRETARY asked for the complete distribution of the genus *Neuropogon*. Mr. LAMB replied that with the exception of one widely distributed species it was otherwise antarctic. He then asked if the widely distributed

species could be considered parental. To this Mr. LAMB replied that he was unable to supply any satisfactory answer to this question; there was as yet too little evidence available for the construction of any phylogenetic scheme of evolution within the genus.

Mr. D. J. SCOURFIELD asked whether the alga associated with the fungus in the lichens referred to was the same or similar to the one most usually found in British forms. Mr. LAMB replied that they are of the type known by some as *Cystococcus*, by others as *Protococcus*.

The PRESIDENT commented on the interest of chemical reactions in the Lichens and the new technique connected therewith.

Capt. GUY DOLLMAN, F.L.S., exhibited a series of photographs and gave an account of 'The post-natal development of Kangaroos'. [Printed in full below.]

Miss C. K. RICARDO, F.L.S., gave an account of her paper, 'The Fishes of Lake Rukwa'. [This paper will be printed in the Journal, Zoology.]

Abstract.—

The paper is an account of the study of the fish of Lake Rukwa made during September and October 1936. The history of exploration and physical geography of the region are briefly described in it, together with the physical and chemical characters of the water and the general conditions of life in the lake. Examination of the distribution of the fish fauna suggests that, although the lake at present is completely isolated, it has not been isolated for a very long period, and that it appears in the past to have had some connection with Lake Tanganyika and with parts of the Congo, Zambezi, and East African drainage systems.

Twenty-four species have now been recorded from the lake, and these include one species and one subspecies that are new, and eight that had not previously been recorded from this region. The bulk of the paper contains taxonomic and ecological details for each of the different species.

Discussion.—

Mr. J. R. NORMAN congratulated Miss Ricardo upon the completion of what he considered to be an excellent piece of research and a valuable contribution to our knowledge of the fish fauna of the African lakes. At the same time he drew attention to the important evolutionary problems supplied by a study of the fauna of these lakes.

Dr. W. T. CALMAN asked for information on other living animals living in association with the fish.

The PRESIDENT and Mr. M. A. C. HINTON also spoke.

In reply, Miss Ricardo said that the fauna was rich in individuals, but rather poor in species. Zooplankton was abundant, but none of the larger Crustacea, such as prawns or crabs, were seen, molluscs seemed to be scarce, but there was a fairly large insect fauna in the vegetation at the edge of the lake. Fresh-water medusae had never yet been recorded from Lake Rukwa.

EARLY REFERENCES TO WATERBLOOM IN BRITISH LAKES.

BY BENJAMIN MILLARD GRIFFITHS, D.Sc., F.L.S.

'WATER-BLOOM' is the name given to the discoloration of the water of lakes by a super-abundance of microscopic free-floating animal and plant life. The normally clear and colourless water is rendered turbid by the presence of the organisms, and assumes a green, brown, or purplish colour, according to the kinds of algae present (see West, 1916, pp. 32, 75, 484). The name is a translation of 'wasserblüte'; Fritsch (1936, pp. 476, 607) calls it 'water-flowers'; Murray (1910, p. 283) refers to the phenomenon as the 'flowering of the water'; another expression for it is 'the breaking of the meres', used in Shropshire to denote the turbidity of the water, which resembles the turbidity or 'breaking' of beer-wort when the yeast begins to work (Phillips, 1883, p. 278). Water-bloom sometimes occurs in small pools, but is more frequent in the larger bodies of water, especially those on the newer geological formations. Water-bloom is relatively uncommon in the larger British lakes (Murray, 1910, pp. 283, 311), most of which are situated on old geological areas, but it is frequent in the meres of Shropshire (Phillips, 1883; Griffiths, 1925), Anglesey (Griffiths, 1926), and Norfolk (Griffiths, 1927), and is very common on the rest of the great North European Plain on the Continent (Wesenberg-Lund, 1910, p. 389).

One of the earliest printed references to British water-bloom is that given in Smith and Sowerby's 'English Botany', 1804 (Smith, J. E., vol. XXI, pl. 1378) for '*Conferva echinulata*', sent by the Rev. Mr. Davies from a lake in Anglesey. It covers the surface of the water in the months of June and July, and consists of innumerable minute globules of a

glaucous or verdigrise green, all nearly of a size'. (See also Griffiths, 1926, p. 362.)

Between 1823 and 1825 Greville gave an account of a purplish water-bloom in Haining Loch, Selkirk (Greville, 1823-8, description and pl. 303, vol. vi.; see also Hassall, 1852, p. 224; Phillips, 1883, p. 283). In 1837 Thompson described a greenish water-bloom in Ballydrain Loch near Belfast (Thompson, 1837, p. 75; see also Hassall, 1852, p. 279; Harvey, 1841, p. 144). In 1838 Drummond gave a description of the greenish bloom on Glaslough, Co. Monaghan (Drummond, 1838, pp. 1-6; see also Harvey, 1841, p. 163; Phillips, 1883, p. 284; Cooke, 1890, p. 165). In 1846 Dickie described a water-bloom in a loch near Aberdeen (see Phillips, 1883, p. 283; Cooke, 1890, p. 163). In 1883 Phillips published an account of the breaking of ten meres in Shropshire (Phillips, 1883, pp. 277-296; see also Griffiths, 1925). Cooke, 1890, conveniently summarizes many of the older references (Cooke, 1890, pp. 159-176).

A reference to water-bloom much earlier than the foregoing occurs in a work by Giraldus Cambrensis which dates from the end of the twelfth century*. Giraldus Silvester de Barri, surnamed Cambrensis, was Archdeacon of Brecon when in 1188 he accompanied Baldwin Archbishop of Canterbury on a tour in Wales to preach the Crusade on behalf of Henry II (see Mosheim, 1863, pp. 134, 219). Giraldus wrote an account of the Archbishop's journey. I have used the Latin text of David Powel, 1804 (Powel, 1804) and a translation of the Latin text by Sir R. C. Hoare, 1806 (Hoare, 1806). The quotation from Hoare, p. 25, is as follows:— 'Chap. 2. Journey to Hay and Brecheinoc. I have determined not to omit mentioning those occurrences worthy of note which happened in these parts in our days. It came to pass before that great war in which nearly all this province was destroyed by the sons of Jestin, that the large lake and the river Leveni which flows from it into the Wye opposite Glasbury, were tinged with deep green colour. The old people of the country were consulted and answered that a short time before the great desolation caused by Howel, son of Meredyth, the water had been coloured in a similar manner'.

A second reference follows on p. 38, 'The lake also (according to the testimony of the inhabitants) is endued with miraculous powers; for, as we have before observed,

* My attention was first drawn to Giraldus by a note in Michaud's 'History of the Crusades', transl. W. Robson, London, 1852, vol. III, appendix 23, pp. 408-9. The note evidently referred to water-bloom, but it was a translation of a French paraphrase of the original Latin and was too confused and inaccurate for use.

it sometimes assumed a greenish hue, so in our day, it has appeared to be tinged with red, not universally, but as if blood flowed partially through certain veins and small channels'.

The large lake is Lake Llangors, also known as the lake of Brecheinoc, Llyn Savaddon (Hoare, 1806, pp. 63-4), Llyn Sevathan (Leland, 1744, p. 66). It is situated in Brecknockshire, a few miles east of Brecon and south of Hay. It is supplied by the river Leven which flows out of the lake northward and enters the Wye near Glasbury. The lake is two miles long and one mile broad, and at its deepest is 'thirteen fathom' (Leland, 1744, p. 66) or 78 feet. Its banks are low and flat and covered with rushes and other plants to a considerable distance from the shore (Hoare, 1806, p. 64). The lake is not mentioned by Murray (1910, pp. 575-577) in his list of Welsh lakes.

It is evident that Giraldus is describing a water-bloom, though not one witnessed by himself. The colour is given as 'viridissimi' and also as 'viridis' (Powel, 1804, p. 10), so that the bloom was probably Cyanophyceae in character. It is also clear that the flowering of the water was a rather exceptional thing and was consequently considered to be a miraculous prognostication of coming trouble. The occurrences of water-bloom are very varied; in some lakes water-bloom is continuous, in others seasonal, in others irregularly seasonal, and in yet other cases occurs only at long intervals (see Wesenberg-Lund, 1910, p. 389; Phillips, 1883, pp. 288-295; Griffiths, 1925, p. 79; Drummond, 1838, p. 5; Thompson, 1837, p. 76). In the time of Giraldus, Llangors Lake must have been of the last class.

The reference to the red coloration 'as if blood flowed partially through certain veins and small channels', is at first glance very mysterious, but it is explained by Leland, c. 1536, who says (1744, p. 66; 1906, p. 107): 'Leveny cummith through the lake, no great river, and after great rain is parfightly seen of redde color in the middest of the lake', and again (1744, p. 64; 1906, p. 104), 'This lake is cawld in Walsch Llin Seuathan. Here one thing is to be noticed that after great regne Lleueney cummeth owt of the montaynes with such a rage that he bringethe the colour of the dark redde sand with him, and ys seen by the color where he violently passeth thorowgh the mere'. Camden, 1586 (1806, p. 97) gives a more teleological explanation as follows:—'The little river Leven entering this lake keeps its waters unmingled as by a kind of antipathy which it shows by its colour and is supposed to carry out its own stream without the least augmentation'. According to these 16th century observers therefore, the red colour is of mineral

and not of vegetable origin. Local information at the present time shows that the red coloration is still to be observed much as Giraldus described.

Leland makes no direct reference to water-bloom, though he refers his readers to Giraldus for further information (1744, p. 104), but Leland also makes no reference to water-bloom in the Shropshire meres, though he mentions Hanmere, Ellesmere, Roston (Rostherne), and Blakmer (1744, pp. 31, 36, 85, 88), so it would be unsafe to conclude from his silence either that water-bloom did or did not occur in the lake in his day.

A slightly earlier reference to water-bloom occurs in connexion with the abbey of Souleseat near Stranraer, Wigtonshire*. The abbey was founded about 1148 (see Spotiswood, 1824, p. 398; Gordon, 1875, p. 313; McIlwraith, 1877, pp. 98, 99), dissolved in 1562 and is now entirely destroyed. It was situated on a peninsula in a small lake 'which takes a greenish tint from time to time' (Maxwell, 1896, p. 48) and the monastery was named 'Sedes animarium' or 'Monasterium viridis stagni' (Maxwell, 1896, p. 48) or 'Monastery of the Green Stank' (McIlwraith, 1877, p. 99). The green colour is due to 'a multitudinous development of spore-like vegetable bodies' (Maxwell; Murray, 1910, p. 245), or 'the floating spores of the water plants which grow in it' (McIlwraith).

A reference antedating the above by a few years is found in the 'Anglo-Saxon Chronicle' under the date 1098. The record runs, 'In this year also during the summer in Berkshire at Finchamstead a pond flowed with blood as many true men said who had seen it.' The reference appears to be to a pool which developed a red water-bloom, either Cyanophycean in character like Greville's purplish water-bloom in Haining Loch, or possibly one due to purple sulphur bacteria. What may be variants of the record of 1098 are given on two later occasions in the same Chronicle. Under the date 1100 the record states, 'And at Whit Sunday there was seen in Berkshire at a certain town, blood welling from the earth as many said who had seen it', and under 1103, 'In this year also at Hamstead in Berkshire blood was seen (to spring) from the earth'. Later Chroniclers make the account more spectacular. Florence of Worcester, died 1118, in his Chronicle says (p. 321), 'in the district called Barrucshire blood flowed from a fountain for three weeks', and p. 325, in 1103, 'In the province called Berkshire, in a place called Heamstede, blood was seen by many to flow out of the ground'. William of Malmesbury, died 1143,

* First noted in Miss M'Kerlie's 'Pilgrim Spots in Galloway', London, 1916, p. 42.

under the date 1100, says 'Moreover in the district of Berruaise, in the village of Hamstede, a fountain of blood continued so copiously and uninterruptedly for fifteen days that a neighbouring pool was coloured'. In the county history of Berkshire (vol. III, pp. 241-2), it is stated that 'Under the years 1029, 1098, 1100, 1103, and 1164, the Chronicles record that blood was seen gushing out of the earth at Finchampstead in Berkshire. The well to which this tradition belongs was called Dozzell's Well, and was situated at the edge of the road leading from Finchampstead to Eversley Bridge. Its water was reputed to be a cure for bad eyes. It was destroyed a few years ago when the road was widened'.

If the well was shallow and more in the nature of a spring in a pool the supposition seems probable that the original phenomenon was a red water bloom and that the accounts of fountains gushing blood are later elaborations of the original account. The phenomenon evidently struck the imagination of the monastic chroniclers and the following references to it also occur in addition to the three already cited:—Simeon of Durham, died 1130, says under date 1103 'in the province called Berkshire at the place called Heamstede, blood was seen by many to flow from the earth'. Robert de Monte, died 1186, says under date 1103 'blood was seen bubbling out of the earth at Hamstade in Berkshire'. Roger of Wendover, died 1237, says under date 1099 'blood was seen to ooze out of the earth at Finchampstead in Berkshire'. In the '*Annales Prioratus de Wigornia*' it is stated under date 1029, that 'a certain pool at Finchamstede flowed with blood for three days', and under date 1164 'a certain pool at Finchamstede was turned into blood and remained thus for three days'.

The several dates of occurrence may either be records of repetitions of the phenomenon or merely repetitions of the record. As the chroniclers used previous chronicles in compiling their own, it is perhaps more likely that the discrepancies are due to interpolation and faulty copying of one original record. Roger of Wendover and William of Malmesbury definitely state that the occurrence was a prognostication of the death of William Rufus, 1100. The frequent references to the date 1103, however, possibly indicate repetitions of the event of 1098 or 1099.

The Berkshire record is the earliest account I have found of a water-bloom in Britain. It is by no means the earliest record outside Britain, for there is a reference by Pliny, A.D. 77, who states that 'waters sometimes change their colour, as at Babylon for example, where the water of a certain lake for eleven days in the summer is red. In the summer season, too, the current of the Borysthenes (River

Dnieper) is blue'. The Babylonian lake is on a par with the Finchampstead pool, but the water-bloom of the great Russian river resembles that of the lakes of the European plain through which it flows.

The above account shows that the phenomenon of water-bloom has been observed from very early times. There is some amount of evidence that water-blooms occur rather more frequently than in the past. Thompson (1837, p. 76) says that the water-bloom of Ballydrain Lake had been observed only during the last four or five years. Griffiths (1925, p. 79) in 1924 found water-bloom in Blake Mere, which Phillips stated in 1881 had never been known to break. In the case of Llangors Lake also, the coloration recorded by Giraldus is no longer exceptional, and local information indicates that the lake often takes on a green colour in the summer. It is probable that modern methods of cultivation of the land have tended to enrich the drainage water of the catchment areas of lakes, thus encouraging the development of plankton organisms.

It is also remarkable how very persistent the occurrence of water-bloom in a lake may be. Water-bloom has been present in the Anglesey lakes for over a hundred years, 1804-1923. Llangors Lake has shown water-bloom for some eight hundred years and Souleseat Abbey Loch for even longer.

In conclusion, I wish to thank the following gentlemen for assistance in obtaining information:—Mr. Hyde of the National Museum of Wales; Dr. S. C. Cresswell of Bwlch; Rev. Thomas Jones, Vicar of Llangorse; and Mr. Bertram Colgrave, Reader in English, the University, Durham, to whom I am particularly indebted for access to relevant literature and assistance with translations from the Latin.

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The Chronicles of Roger of Hovenden, Matthew Paris, Randolph of Coggeshall, William of Newburgh; Chronicle of Melrose; Giraldus Cambrensis, 'Concerning Instruction of Princes'; Bede's Ecclesiastical History; The Mabinogion.

Discussion.—

Professor F. E. WEISS stated that the phenomenon had been observed in the early years of the present century by the late Canon Rawnsley of Keswick, who sent him for identification some of the algae from Derwentwater producing it. Canon Rawnsley was shocked that the organism causing such beautiful colour-changes should go by the name so evil-sounding as *Gomphosphaeria aponina*.

Dr. ANNA HASTINGS suggested that the more frequent occurrence of waterbloom nowadays was in accordance with Pearsall's theory of the evolution of lakes.

Mr. D. J. SCOURFIELD said that it was now very well known that the coloration of water could be brought about by many

different microscopic organisms. These were usually algae, but other forms were sometimes the cause. For instance, he had seen a pond in Epping Forest of such an intense purplish-red colour that the water appeared to have been turned to blood, and this was due to one of the sulphur-bacteria, *Chromatium Okenii*. This case had been put on record in the *Essex Naturalist* *. The change from green to red or vice versa, which had been mentioned, could be brought about by certain species of *Euglena* which had the power, under certain conditions, of changing in that way.

POST-NATAL DEVELOPMENT OF KANGAROOS.

BY GUY DOLLMAN, B.A., F.L.S., F.R.S.A.

[PLATES 1 & 2]

THE Natural History Museum has recently received from Mrs. M. V. Walker, as a donation, a set of wonderful photographs depicting the early life-history of the kangaroo taken by her husband, the late Dr. W. D. Walker. Dr. Walker, it will be remembered, was killed in an aeroplane accident in this country last August; he was keenly interested in flying as a help to medical science in Australia, and was himself a pilot of some experience, having been attached to the Royal Air Force as a doctor and pilot for some years. To be the Flying Doctor of the Australian bush was his aim. In addition to the photographs of kangaroo development Dr. Walker also took a large number of other photographs of men and beasts in Australia, and for these he received the Gold Medal of the Royal Photographic Society.

This series of photographs of young kangaroos was taken some years ago and is undoubtedly one of the finest records of the post-natal development of any animal ever obtained, showing as it does nearly all the phases from the newly-born young to the mature specimen. It is obvious that such results could only have been obtained after the examination of many hundreds of kangaroos and their young, and that these photographs will remain for all time a record of the painstaking researches carried out by Dr. Walker.

When first born the young kangaroo is very minute and immature, being little more than an inch in length and looking more like a fragment of raw flesh than the young of any animal. This embryonic appearance of the newly born young is commonly met with in marsupials, since instead of being born in a more or less advanced state, as is the case in the placentals or Eutheria, they are brought forth at a very

* Vol. XXI, 1926, p. 154.

early stage : in a great number of species there is no placental connexion between the developing embryo and the maternal uterine tissues. In these marsupials where no placental link is developed, the necessary nutriment for the growth of the developing embryo is largely derived from the embryonic envelopes which surround the vesicle, the latter never having been attached to the uterine walls. This arrangement appears to be quite sufficient for the very short period of foetal life which these marsupial embryos have to undergo.

There is one curious point about some of the smaller and more prolific marsupials which is worthy of note, and that is that over-production occurs occasionally. Sometimes nearly twice as many young are produced as there are teats in the mother's pouch to accommodate them, resulting, of course, in a high rate of mortality among young foetuses. There is a scramble for the teats and the unlucky ones are doomed to extinction. This has been noticed in the American opossum where as many as 23 foetuses have been recorded for 13 nipples.

It is rare, however, to find all the 13 teats occupied, though whether this is due to the small size of the litter or early post-natal mortality is not yet known. Still more marked is the number of eggs and embryos which perish *in utero*, though a number of eggs will be found unfertilized. The term 'egg' for the early stages of development of the young marsupial is not by any means a misnomer, since the fertilized ovum surrounds itself quickly with a shell-like membrane rather similar to that found in the egg-laying Prototheria (Platypus and the Echidnas), in which types this egg-shell persists after birth until the hatching of the eggs. The marsupials are the highest of the mammalia in which such a shell-like structure occurs.

Up to the year 1913 it was generally believed that the young of the kangaroo and other marsupials were placed in the pouch by the mother as soon as they were born. For instance, we read in 'Mammals Living and Extinct', that classic work by Flower and Lydekker, the following passage relative to this question :—' In this pouch the young are placed as soon as they are born : there their growth and development proceeds and to it they resort temporarily for the purposes of shelter, concealment and transport. . . . ' In 'The Western Mail' of Perth, Western Australia, dated January 3rd, 1913, there was published an article by Mr. A. Goerling on some observations made in the year 1906 on the birth of a young red kangaroo, *Macropus rufus*. In this article Mr. Goerling tells how he observed the newly born kangaroo make its way up to the entrance of its mother's pouch and, entering the pouch, travel onwards towards the nipples. He states

that the new-born kangaroo had to look after its own safety and reach the pouch without any assistance on the part of the mother: during the whole time occupied by this journey, about 30 minutes, the parent paid no attention whatever to her offspring, leaving it entirely to its own exertions.

The young of these marsupials have the fore legs and head much more massively developed than the hind-quarters, the hinder parts being weak and the whole effect being rather grub-like. The young kangaroo progresses through the hair of the abdomen and pouch by means of alternate movements of its arms, the action resembling that of the over-arm stroke in swimming, the head moving from side to side during the animal's progress. Arrived at the nipples it quickly fastens itself on to one, the nipple at once filling the cavity of the young one's mouth in such a manner that it cannot be detached without rupture. The suggestion that the mother kangaroo actually pumps, by muscular exertion, milk into her young is not substantiated by fact: the young of kangaroos and opossums have been observed to suck at the teats in a perfectly normal manner.

In the case of the kangaroo the young remains attached to the nipple for nearly four months; during this time it has grown to look like a kangaroo and assumed a coat of hair. After this it begins to take notice of life outside the pouch, occasionally feeding off such vegetation as it can reach by stretching out its head. At a later date it emerges from the pouch and commences its life as a separate individual: but it is for a long time dependent upon its mother's pouch for cover when danger threatens.

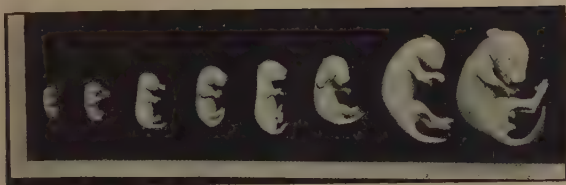
A very similar state of affairs has been noticed in the development and birth of the American opossum (*Didelphys virginiana*) and has been dealt with at some length by Carl Hartman in the 'Anatomical Record' for October, 1920, and the 'Smithsonian Report', 1921. In this latter publication the author states that the young reach the pouch without the aid of the mother and that the embryonic life *in utero* of the foetuses is only 11 days; but, nevertheless, at birth they have sufficient neuromuscular coordination and sensory response to clamber up from the vaginal orifice into the pouch, find the teats in amongst a maze of hair, and attach themselves for two months where they will be sure of warmth and food. Among Dr. Walker's photographs is one showing a series of young opossums, from birth up to about 6 weeks; these animals are undoubtedly the young of the Australian opossum (*Trichosurus vulpecula*), and at this stage they very closely resemble the young of kangaroos and of the American opossum.

In other groups of marsupials the pouch opens backwards

as is seen in the Native Cats (*Dasyurus*), Bandicoots (*Peramelus*, and *Isoodon* etc.) and the pouched mice (*Sminthopsis*): in such cases the journey of the young to the pouch must be a shorter and easier one than in the kangaroos and opossums, where the pouch opens forward and the young have first to travel over the wall of the pouch.

Although no pouch is found in the Platypus, among the Prototheria, a temporary marsupial structure is developed in the female sex of the Echidnas during the breeding season, and it has been observed that the egg has been deposited in this structure and there hatched. In this case the young one is carried about in its mother's pouch for a time until its spines become sufficiently rigid to advertise themselves and the mother is forced to find a safe retreat in which to place her spiny youngster.

The first of Dr. Walker's photographs shows the pouch of a kangaroo with the newly born young one hanging on to one of the teats; its journey up to the pouch has only just been completed and it is seen with its mouth firmly attached to the nipple. In the next of the series we have a closer view of the same individual. Then follows a photograph of eight young kangaroos ranging from the newly born one to one of about 6 weeks old. The newly-born kangaroo will be seen to be scarcely more than an inch in length. In the first five or six of this series the head and fore-limbs are disproportionately large and the hind-quarters weak, the last two or three show the hind-limbs, feet, and tail growing more quickly than the fore part of the body. The weak development of the hind quarters in the initial stages in these marsupials is a feature which would appear to be maintained throughout the group; it is seen in the series of four young Australian opossums photographed by Dr. Walker and also in the young of the American opossum (*Didelphys virginiana*) figured by Hartman in the 'Smithsonian Report' for 1921, pl. ii. fig. 6. Other photographs show the development at three, seven, ten, and fourteen days; in the latter the hind-limbs and tail have grown to balance the fore part of the body. Of the later stages in the development there is a photograph of a young kangaroo feeding on some leaves while still in its mother's pouch, and in another one we see a half-grown kangaroo, or 'joey', as it is called locally, being carried in the pouch with its hind feet sticking out just above its head. Two other photographs show the method of emergence and entrance to the pouch and there are others depicting the young kangaroo leading an independent existence for the first time. These pictures show us a very long-legged animal which evidently has some difficulty in balancing itself at this early stage.



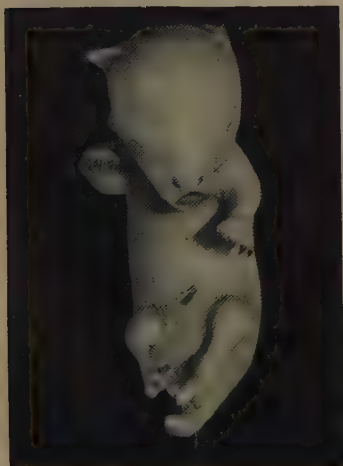
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THE POST-NATAL DEVELOPMENT OF KANGAROOS
AND OPOSSUMS



These photographs undoubtedly constitute a most valuable record of the post-natal development of the kangaroo, and thanks are due to Mrs. Walker for permission to publish some of them.

EXPLANATION OF THE PLATES.

PLATE 1.

- FIG. 1. Series of eight young Kangaroos from the moment of birth up to about six weeks. (Reduced.)
 FIG. 2. Young Kangaroo about 10 days old, showing prominent nostrils above wide open mouth.
 FIG. 3. Young Kangaroo about 7 days old, with ruptured teat still in mouth.
 FIG. 4. Young Kangaroo about 10 days old, showing development of pouch.
 FIG. 5. Young Kangaroo 14 days old with hind-quarters outgrowing fore-quarters.

PLATE 2.

- FIG. 1. Development of Australian Opossum (*Trichosurus vulpecula*), showing phases from birth to about six weeks old. (The series runs from right to left.)
 FIG. 2. Young Kangaroo just out of the pouch learning to balance itself.
 FIG. 3. Young Kangaroo emerging from pouch.
 FIG. 4. Young Kangaroo just out of pouch.
 FIG. 5. Young Kangaroo carried in its mother's pouch.

PROCEEDINGS OF THE GENERAL MEETING

24 November 1938

Mr. J. RAMSBOTTOM, O.B.E., M.A., Dr.Sc., President,
 in the Chair

The Proceedings of the General Meeting held on Thursday, 10 November 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Hamilton Blackiston.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Charles Russel Metcalfe ; for the first time, in favour of Alice Mary Geldart and Mohammad Sayeedud-Din.

The following candidates were balloted for and elected Fellows :—The Rt. Rev. Arthur Cayley Headlam, M.A., D.D., Bishop of Gloucester, Thomas Alan Oxley, B.Sc., Sidney Robert Brown Pask, M.A., Tom Stansfield, M.B., B.S., Royden Samuel Wale, M.D., Margaret Halley Chambers, B.Sc., Bruce Pollard-Urquhart, B.A., Arthur John Carpenter, B.A., Robert Roderick Broome, Raman Kesavan Nair, B.Sc., Ph.D., and Patroclos Demetrios Critopoulos, D.Sc.

The President reported the death of Mrs. Elsa Landby, a candidate for election as a Fellow at the present meeting ; also the death of Andrew Edmund Castle Stuart, a Fellow of the Society.

Mr. J. R. NORMAN, F.L.S., gave an account, illustrated with lantern-slides, of 'The Remoras or Shark-suckers (*Echeneididae*)'. [Printed in full below.]

Major F. C. STERN, O.B.E., F.L.S., gave an account, illustrated with lantern-slides, entitled 'A Geographical Survey of the genus *Lilium*'. [Printed in full below, p. 29.]

THE REMORAS OR SHARK-SUCKERS (*ECHENEIDIDAE*).

BY Mr. J. R. NORMAN, F.L.S.

(With 2 Text-figures)

THESE interesting fishes, forming the order *Discocephali*, are distinguished especially by having the first or spinous dorsal fin transformed into an oval, laminated, adhesive disc, and placed anteriorly on the upper surface of the head. By means of this disc they are able to attach themselves to sharks and other large fishes, marine mammals, turtles, and sometimes to ships or to floating wreckage. In their general anatomy, as well as in the form of the other fins, they resemble the *Percoids*, and Regan* has suggested that they may well have evolved from *Percoids* of the type of the *Pomatomidae*, *Carangidae*, *Rhachicentridae*, etc.

There are about ten existing species, which fall into two well-marked groups: the *Echeneis* group, with an elongate slender body, striped on the sides; and the *Remora* group, with a short, rather robust body, uniformly grey, brown or black in colour. The Remoras are all carnivorous fishes,

* 1912, *Ann. & Mag. Nat. Hist.* (8) x, p. 634. See also Gill, 1898, in Jordan & Evermann, *Bull. U.S. Nat. Mus.* XLVII (3) p. 2265, for a discussion of the systematic position of the *Discocephali*.

and are to be found in most warm seas. One species is an occasional visitor to our own shores. The larger forms attain to a length of nearly four feet.

Although a highly specialized organ, the cephalic disc can be shown to be composed of all the typical elements of a spinous dorsal fin, the paired laminae, varying in number in the different species from 9 to 36, representing the much modified fin-spines, which have become shortened, depressed posteriorly, and expanded transversely. Posterior projections of each pair of laminae are joined by ligament in the middle line, and a low fin-membrane connects them with the next pair*. It is difficult to imagine the initial stages in the formation of such an organ, but Regan has suggested that some pelagic Percoid fish like the Pilot-fish (*Naucrastes*), which has the habit of associating with sharks, may have found that the spinous dorsal fin, when depressed in its groove, had a certain power of adhesion, and in this way acquired the habit of attaching itself to its protector.

The mechanism of adhesion seems to be as follows. When the flat surface of the disc is applied to the skin of the host the marginal membrane creates a partial vacuum, enabling the Remora to obtain a hold. Then, a slight raising of the transverse laminae creates a series of subsidiary vacuum chambers, and firmer adhesion is established. The denticulations on the upper surfaces of the laminae prevent the disc from sliding, and play their part in preventing the fish from being swept off as the host makes its way through the water. It is a difficult matter to dislodge a Remora by a backward pull, as this tends to raise the edges of the laminae and thus to increase the hold, but by sliding it forward the laminae are lowered and the fish more or less readily detached. An interesting feature of the attachment is that the action of the disc seems to cause inhibition of all movement of the body and tail, only the movements of the mouth and opercula necessary for respiration being maintained †.

Remoras feed mainly upon other fishes, which they pursue freely in the water, but probably obtain a share of the host's meals from time to time. The advantage gained by the association is twofold: they obtain a measure of protection by the proximity of the more formidable host, and they are transported without effort on their part from one feeding ground to another. Once among a shoal of fish, they will loose their hold and feed freely, only seeking a fresh anchorage when appetite is satisfied. Some of the smaller species are

* See Beck, 1879, 'Ueber die Haftschiebe der *Echeneis remora*', Inaug. Diss., Schaffhausen; Storms, 1881, Ann. & Mag. Nat. Hist. (6) II, p. 67; Houy, 1909, Zool. Jahrb. Abt. Anat. xxix, p. 101.

† Hora & Sewell, 1925, 'Nature', cxv, p. 48.

found within the mouths of whales, sharks, and giant rays, and others regularly seek shelter inside the branchial cavities of swordfishes, sailfishes, barracoutas, and other large oceanic fishes*.

A fossil Remora, *Opisthomyzon glaronensis* (Wettstein), from the Upper Eocene of Switzerland, although throwing little light upon the origin of the group, is nevertheless of considerable interest. In this fish the disc, consisting of about six laminae only, in addition to being smaller and narrower than its modern counterpart, is placed farther back

TEXT-FIG. 1.



Capiculum. xxxvj.

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*Zbenay vel Echyni. pñio. Echeneis
parvus ? semipedalis pñicial? nome
sumpit ex eo q nauem adherendores*

One of the earliest-known printed figures of the 'ship-holder'. From Johann von Cube's 'Ortus Sanitatis', 2nd Ed., Leipzig, 1490.

and does not extend as far as the interorbital region of the head. The broader opercles and widely forked caudal fin of the Eocene fish indicates that it was a stronger and more active swimmer than its descendants.

The available embryological evidence, although as yet far from complete, is also illuminating†. The eggs of the Remoras are pelagic, and the free-swimming post-larval life of somewhat short duration. Examination of a series of larval forms of *Echeneis* or *Remora* shows the adhesive disc

* Gudger, 1926, Amer. Mus. Novit. no. 234, p. 22.

† See Tåning, 1926, Comptes-Rend. Acad. Sci. Paris, 182, p. 1293; Tåning, 1927, 'Nature', cxx, p. 224; Sanzo, 1928, Mem. Com. Talass. Ital. 138, p. 1.

developing in the position normally occupied by the spinous dorsal fin, and afterwards undergoing a gradual anterior migration to the final position on the head.

A notable and persistent myth associated with these fishes concerns their alleged power to retard the progress or even to stay the course of a ship, and the Greek term *Echeneis* (one that holds back a ship) and the Latin *Remora* (a holding back) both refer to this legend. It was already current in the time of Aristotle, and is repeated in classical, mediaeval, and renaissance literature *. Further, the term 'Remora'

TEXT-FIG 2.



Fishing with the Remora. From Conrad Gesner's 'Historiae Animalium', Lib. iv, 1558.

has attained a definite place in literature, and especially in English literature of the sixteenth and seventeenth centuries. Thus, Spenser has the following :—

All sodainely there cloue vnto her keele
A little fish, that men call *Remora*,
Which stopt her course, and held her by the heele,
That winde nor tide could moue her thence away.

And Ben Jonson applies the term to a tedious bore :—

'Death, I am seiz'd on here
By a Land-Remora.

In various parts of the world the natives make use of the *Remora* to catch large fish, turtles, dugongs, etc., and many

* Gudger, 1918. Ann. & Mag. Nat. Hist. (9) II, p. 271.

accounts have been given of the methods employed*. Generally a ring is fastened to the tail of the Remora, and to this is attached a long cord. The fish is kept on board in a bucket of water, and, when the quarry is sighted, it is released. It attaches itself to the quarry and both are pulled in together, great care being taken to put no undue strain upon the line with the probable result of detaching the Remora or pulling the ring from its tail. Sometimes a second line is passed through the mouth and out through one of the gill-openings, and when the boat sets out the Remora is set free in the water, merely being leashed by the head-line. The advantage of this second line seems to be that if the fish attaches itself to the boat it can be released by a forward pull. The employment of the Remora in fishing is first mentioned in the early part of the seventeenth century, in an account of the second voyage of Columbus to the New World, and the story is to be found, often with quaint illustrations, in many of the early works of natural history.

Discussion.—

SIR A. SMITH WOODWARD remarked that numerous well-preserved skeletons of Carangidæ had been found in the limestone of Monte Bolca, northern Italy, which was geologically older than the deposits in which the fossil remoras had been discovered. None of these Carangidæ showed any modification of the anterior dorsal fin approaching that of the remora. Here therefore was another illustration of the imperfection of the geological record.

LT.-COL. R. B. SEYMOUR SEWELL: Mr. Norman has mentioned the somewhat rough experiments that I carried out on some of these 'Sucker-fish' when I was on the R.I.M.S. *Investigator*, and I may perhaps be allowed to amplify these remarks.

A shoal of these fish were swimming round the vessel as she lay at anchor and Captain Daughish, who is a keen fisherman, was amusing himself by catching them with a rod and line. In one case the hook got caught deep in the fish's throat and, not wishing to sacrifice a hook, he asked me to help him to get it out. The fish was actively flopping about on the deck; but when I turned it over to get at the mouth, it immediately adhered to the deck planking by means of its sucker. I then found that I could remove the hook by cutting away a part of the lower jaw, and throughout the whole process the fish lay absolutely still; so far as I can remember, even the usual respiratory movements of the mouth and gill chamber also ceased. The next time a fish was caught,

* Gudger, 1919, Amer. Nat. LIII, pp. 289, 446, 515.

I placed it against the bulkhead and the fish hung there by its sucker without a movement while the hook was being cut out. It would appear that there must be some sort of nervous connection between the sucker and the voluntary muscular system of the rest of the body and that when the sucker is in action some inhibitory mechanism causes a complete cessation of action of the rest of the voluntary muscles. In life such an inhibitory mechanism would be possible, for when the fish is attached to a large moving body, such as a ship's bottom or to a shark, it will be carried about without any need for activity, apart from the adherence of the sucker, by the action of its host; and, when so attached, the sucker fish will naturally become orientated so that its head will be pointing in the direction in which it is being carried, all that will then be necessary for its respiration is for the fish to keep its mouth open and a continuous stream of water will automatically flow into the mouth and through the gills, thus aerating the blood without any activity on the part of the fish itself.

Sir SIDNEY HARMER enquired whether the lamellae of the sucker could be regarded as short, transversely elongate fin-rays.

Dr. W. T. CALMAN and Prof. W. GARSTANG also spoke.

A GEOGRAPHICAL SURVEY OF THE GENUS *LILIUM*.

By Major F. C. STERN, O.B.E., M.C., F.L.S.

THE genus *Lilium* is distributed only in the Northern Hemisphere. This distribution is on the same lines broadly as that of several other genera belonging to the Northern Hemisphere, as for instance *Primula* and *Gentiana*. The greatest concentration of these genera is in Eastern Asia and from there they radiate mostly east and west with a few attempts to go north and south: the *Primulas* have been successful in one or two places in getting south of the Equator. Species of all the different sections of lilies are found in Eastern Asia; and here also are found two closely allied genera, *Nomocharis* and *Notholirion*; these are not found in any other part of the world.

All the different species of *Lilium*, *Nomocharis*, and *Notholirion* can be grown in some garden or other in the British Isles with perhaps the two exceptions which come from the most southerly localities where lilies are found—*L. philippinense* from the north of the Philippine Islands and *L. neilgherrense* from the Nilghiri Hills of Southern India.

In Europe lily species extend from the Pyrenees eastward north of the Mediterranean. In the Pyrenees there is *L. pyrenaicum*, the yellow martagon. All the European lilies are plants of the dry hill-sides and they are all with one exception of the Martagon type. Many of them are found on limestone and all of them will grow on calcareous soils. Further east in the Maritime Alps is the scarlet martagon *L. pomponium* which is restricted to a comparatively small district. In the French and Italian Alps and in Switzerland is found *L. aurantiacum* (syn. *L. croceum*), a yellow species of the Pseudolirion section with a cup-shaped flower. This is the exception I spoke of. *L. Martagon* is the commonest lily of Europe extending from Portugal through Europe to European Russia and is found in England. This lily grows easily in any position or soil and seeds freely; so perhaps some of the so-called wild Martagons may be escapes. The finest forms of Martagon are found in Dalmatia. In the Balkan Peninsula, especially in the Greek mountains, a deep red Martagon is found, *L. chalcedonicum*, which is quite a different species to the red lily of the Maritime Alps. Going eastwards into the Caucasus there is a strong-growing yellow lily of the martagon type, *L. monadelphum* and several varieties. This lily is only found in a comparatively small district of the Caucasus extending south into Armenia and Asia Minor.

It is not known where *L. candidum*, the beautiful lily of our cottage gardens, is found wild. It is depicted on the Minoan vases and on Egyptian monuments, so it has probably been in cultivation for some 3,000 years. Forms have been found wild around Salonika, but possibly northern Palestine may be its true home.

From Asia Minor eastwards there is a gap, and the next lily is found in eastern Afghanistan extending to Kashmir. It is *L. polyphyllum*, a small white Martagon, not easy to grow in Britain, but it has been grown successfully out of doors at Kew and elsewhere.

In the Himalayas there is the magnificent *L. giganteum* growing to some 8 ft. high, and further east in the Chinese Mountains a smaller variety *yunnanense*, another form being found in northern Japan, *L. cordatum*. These three lilies, forming the Cardiocrinum group, are indigenous to Eastern Asia.

In the central Himalayas there grows *L. nepalense*, a yellow trumpet lily; then further east in northern Burmah there is another yellow lily now called *L. ochraceum* var. *burmanicum*. This lily has much the same colouring—yellow petals with a deep brown blotch at the base—as *L. nepalense* but it is more like a martagon type than the trumpet type—in fact, it is

about halfway between the two. Then further east in China going down to Siam one finds *L. ochraceum* a variable lily with much the same colouring, but a true Martagon in shape. Kingdon Ward has just reported a new yellow trumpet lily from the mountains of Assam.

In northern Burma there is also a beautiful white trumpet lily, *L. myriophyllum* var. *superbum*. There are several species of this white trumpet Section represented in Eastern Asia. This lily comes from the high valleys where there is abundant rainfall; there is another trumpet lily, *L. Sargentiae*, from the low valleys of Szechuan where there is also abundant rainfall. These two lilies dislike growing in lime.

Two more white trumpet lilies come from the highlands of the Chinese Alps, *L. leucanthum* var. *centifolium* from Hupeh and *L. regale* from western Szechuan. Wilson found the latter in 1903 in one semi-arid valley, and nowhere else. It is probably more largely grown in gardens in England to-day than any other lily. Both these lilies grow well on lime. It seems as if the lilies which grow where there is abundant rain dislike lime, while those of the drier or more arid positions have no such dislike of lime.

There is a hybrid lily, *L.* × '*G. C. Creelman*', the result of a cross between *L. Sargentiae* and *L. regale*, that is a cross between a wet district lily and a dry district lily. It is interesting that this lily has no dislike of lime.

I know of no hybrid with *L. regale* as the mother plant.

There are several species of the Martagon type throughout China, and in Korea *L. amabile*, *L. cernuum*, and others. Of the yellow forms *L. Henryi* growing up to 8 ft. high comes from the limestone cliffs in the province of Hupeh and another martagon *L. Davidi* var. *Willmotiae* from western Szechuan. Several hybrids have been made with this lily, e.g. one crossed with *L. dauricum* a cup-shaped yellow lily called *L.* × '*Lilian Cummings*'. Of the white Martagons of China perhaps *L. Duchartrei* is the most attractive. It is found high up at about 10,000 feet in the mountains of Szechuan.

L. pumilum is the most northerly lily found in Asia, extending from North China to Siberia. The section Pseudolirion or cup-shaped flowered lilies is represented by several species and perhaps the best known is *L. dauricum* from NE. Asia which was the first Asiatic lily to be introduced to England in about 1740. In the south of China there are forms of *L. Brownii*, a most beautiful trumpet lily. In the Island of Formosa another trumpet lily has been found, *L. formosanum*, a late flowering lily. The only other lily found in the far south is a newly discovered pale yellow martagon *L. Poilanei* from northern Indo-China, which has not yet come into experimental cultivation. It is said to be marked with red stripes.

In Japan there are several endemic lilies. The beautiful *L. auratum* is the only species in the section *Archelirion*. Among the *Martagons* is the well-known *L. speciosum* and the yellow-flowered *L. Maximowiczii*. Japan is unique in having two pink-flowered trumpet lilies, *L. japonicum* and *L. rubellum*. None of the Japanese lilies will grow in lime.

In North America all the species except one follow the lines of the eastern and western seaboard, and are mostly known as 'swamp lilies'. That is not really a true description, for although they are all, except one, plants of the valleys, they all need, like all lilies, good drainage to grow properly: they are usually found just above and around swampy peaty ground.

The one exception is *L. philadelphicum* and its varieties, which extend from the eastern seaboard across the northern U.S.A. and Canada to the Rocky Mountains. On the west in California and Oregon are two fine lilies, *L. washingtonianum*, a white trumpet lily dying off mauve, and *L. Humboldtii*, a *Martagon* having yellow 'petals' with black spots. They are both magnificent lilies; they both have a very curious formation of the bulb. All the American 'swamp lilies' except these two have *rhizomatous* or stoloniferous bulbs, but these two have bulbs somewhat half-way between the normal *symmetrical bulb* of the lilies of the Old World and the stoloniferous bulb of the American swamp lilies.

Perhaps best known of the western American lilies is *L. pardalinum* from California and Oregon. It is a lily easily grown in any fairly moist soil and is the only American lily which will stand lime. It crosses very easily with the other American lilies of the same type.

A most charming yellow trumpet lily comes from southern California, *L. Parryi*, from the mountains at about 8,000 ft. It is found alongside the mountain streams, where it is moist most of the growing season and kept dry in winter by the ground being frozen up.

A hybrid lily made in America with a somewhat mixed parentage of western American lilies is that called *L.* × '*Shuk-san*'. The parentage is said to be *L. Humboldtii* × *L. Parryi* crossed with *L. pardalinum*.

In eastern America from the province of Quebec southwards to Georgia there is a common lily of the woods, *L. canadense*. It is one of the most charming lilies in existence—the yellow flowers hang down on delicate stems looking like fairy pagodas. *L. Grayi*, of the same type, comes from further south on the eastern seaboard from Virginia and N. Carolina. It is a near relative of the *L. canadense*, only smaller in all its parts with a deep red flower with the 'petals' spotted inside.

Another very fine lily grows all along the eastern coast.

This lily grows 6 ft. high and has many Martagon shaped flowers of yellow splashed with red. This magnificent lily was named in 1762 *L. superbum* by Linnaeus.

Discussion.—

Mr. ARTHUR GROVE: Before passing to Major Stern's paper, I should like to felicitate him on the excellence of the slides he has just shown us. In an experience of 40 years, I have not seen their equal.

Major Stern has dealt so lucidly and comprehensively with his subject that there is little left to say about it. The distribution of *Lilium* as conceived by Elwes 60 years ago still holds good. He foresaw that if further species were to be discovered, it was more likely to be in western China than elsewhere; but he certainly did not visualize the wealth of new species that botanical exploration was to discover there.

It is unlikely that further new species will be found. Possibly, something has still to come from about the Mexican border of California or the northern frontier of Burma; but, if so, it can hardly be of great garden value.

Sir ARTHUR HILL expressed his admiration of the excellent photographs and his appreciation of the very interesting way in which Major Stern had dealt with the lilies on a geographical basis. He pointed out that, though Major Stern had not mentioned the fact, the greater number of the photographs had been taken in his garden at Highdown, Goring-on-Sea, situated on the chalk down. His success in the cultivation of lilies was therefore all the more a matter of congratulation.

Mr. A. D. COTTON emphasized the great concentration of species of *Lilium* in Eastern Asia, with representatives of all Sections of the genus and including all the true Trumpet lilies. Many species have restricted distribution, but *Lilium Martagon* was remarkable in extending from the Alps to Siberia, though in varying forms and varieties.

No species were common to Asia and America, and the American species as a whole do not appear to have close affinity with those of the Old World. On account of the form of the flower most of them are placed in the Section Martagon, yet they differ from the Old World species in several characters and very markedly in the structure of the bulb.

Mr. EDMUND BAKER stated he had had the pleasure of going over Major Stern's garden this summer and was much interested in his lilies; also in his remarkably fine collection of *Eremurus*.

Professor G. D. HALE CARPENTER suggested that the distribution of the Martagon lily might include Abyssinia,
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the highlands of which contain a strong Palaearctic element, and asked whether any species of lily had been found there.

Professor F. E. WEISS remarked that he was particularly interested to learn from Major Stern's account that the species of *Lilium* from the western regions of America differed not only in their stoloniferous habit but also in the shape of their flowers from those of Asia. It indicated that a considerable time had elapsed since these forms had been geographically separated.

The question as to the tolerance for lime shown by the European forms and intolerance of lime of the Chinese and Japanese species was one requiring further investigation and might well be compared with similar differences in the Gentians.

The PRESIDENT put the question why limestone plants grow in sand.

Major STERN replied that no lilies had been reported from Abyssinia, and that *L. candidum* was said to set seed more readily in a warm climate such as Italy or Greece than in England.

PROCEEDINGS OF THE GENERAL MEETING

8 December 1938

Mr. J. RAMSBOTTOM, O.B.E., M.A., Dr.Sc., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 24 November 1938, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Tom Stansfield, Margaret Halley Chambers, Thomas Alan Oxley, Julian Sorell Huxley, Sidney Robert Brown Pask, and Geoffrey Alton Craig Herklots.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Alice Mary Geldart and Mohammad Sayeedud-Din; for the first time, in favour of Clarice Vivian.

A Discussion on National Parks, with special reference to that at Belair, near Adelaide, was opened by Prof. T. G. B. OSBORN, who gave an account of the Park illustrated with many lantern-slides.

Abstract.—

The National Park at Belair, South Australia, is an area of about 2,000 acres in the hills to the south-east of Adelaide, about eight miles from the city. It was established by Act of Parliament in 1891 'as a place of amusement, recreation and convenience of the inhabitants', and put under the control of a Board of Commissioners. The Commissioners have not a large grant for maintenance, but a considerable addition to revenue is obtained from the hire of 'ovals' or sports grounds, tennis courts, and picnic pavilions. To provide these facilities a certain amount of the original vegetation has been cleared, but the remaining area is in an almost natural state. Probably all the area, in common with most of the Mount Lofty Ranges, has been swept by fire from time to time. It is in order to reduce the danger of fires starting in the dry grass, rather than to bring in revenue, that horses are depastured in the Park for a small fee.

The western end, which lies at an altitude of about 850 feet, is relatively level with an open eucalypt forest of gums (*Eucalyptus rostrata*, *E. viminalis*, and *E. leucoxydon*) and peppermint (*E. odorata*). The natural undergrowth here was grassy, but it has been modified by clearing and grazing. An area of seasonal swamp is of special interest as the habitat of *Phylloglossum Drummondii* and the terrestrial *Isoetes Drummondii*.

The eastern end has several steep-sided hills, which in one corner rise to over 1,600 feet. It is intersected by two main valleys, the bottoms of which have been partially cleared, though magnificent specimens of the original gums (*E. rostrata* and *E. viminalis*) were left. Exotic trees have been planted and the growth of grass encouraged. Here again facilities for sports and picnics have been provided. However, most of the steep valley sides and hills are relatively unaltered. They are covered with a forest of stringybark (*E. obliqua*) or pink gum (*E. fasciculosa*) with a shrubby undergrowth of Proteaceous, Leguminous, and Epacridaceous plants. Altogether, about 350 species of flowering plants and ferns, including about 50 species of terrestrial orchids, have been recorded from the Park.

A measure of the incidence of human interference in the Park is seen from the fact that nearly 150 species of alien plants are naturalized in the area. The indigenous mammalian fauna is probably extinct, but many interesting species of reptiles survive. Eighty-one species of birds have been recorded.

Sir PETER CHALMERS MITCHELL, F.R.S., made the following remarks :—

Definition.

I am asked by the Committee of the Society for the Preservation of the Fauna of the Empire to urge the adoption of the definition employed in the African Fauna convention of 1933 as follows :—

1. The expression ' national park ' shall denote an area :
 - (a) Placed under public control, the boundaries of which shall not be altered or any portion be capable of alienation except by competent legislative authority.
 - (b) Set aside for the propagation, protection, and preservation of wild animal life and wild vegetation and for the preservation of objects of aesthetic, geological, prehistorical, archaeological, or other scientific interest, for the benefit, advantage, and enjoyment of the general public.
 - (c) In which the hunting, killing, or capturing of fauna and the destruction or collection of flora is prohibited except by or under the direction or control of the park authorities.

In accordance with the above provisions facilities shall, so far as possible, be given to the general public for observing the fauna and flora in national parks.

In drafting the foregoing definition the Conference had the advantage of assistance from Government Departments who are skilled in devising precise terminology. The definition, moreover, has been accepted by the Governments of Great Britain, The Union of South Africa, Belgium, Northern Ireland, Egypt, Spain, France, Italy, Portugal, and the Anglo-Egyptian Sudan. Moreover, another international conference has been arranged to deal with Southern Asia and countries bordering on the South Pacific at which the African Convention is to be taken as the basis. I submit, therefore, that it would be an advantage in our campaign for more National Parks if we could employ the same general definition.

Extension of the Definition.

It is to be noted that the above definition was prefaced by the words ' For the purposes of the present Convention ', and the Conference had in mind areas for the most part of very great extent in tropical or semitropical countries, not close to large centres of population. In the case of National Parks, especially those of smaller size, as for example that near Adelaide in South Australia, if established and supported largely from Government funds, I do not think it would be

right or reasonable to limit the facilities of the general public as strictly as is suggested in the definition of the Convention. I suggest therefore that in such cases (and when the demand comes into existence even in the large tropical or semitropical parks) that there should be provided :—

For the General Public.

A sufficient area, preferably near the best access to the Park, for games of all kinds, restaurants, camping grounds, rest-houses, and so forth.

Rough paths for 'hikers' and push-bicycles traversing the general park, possibly with directions towards or from the entrance marked as in the Forest of Fontainebleau by respectively red and blue arrows painted on rocks or tree trunks. Possibly also within the general park restricted sites for camping or for picnics.

For the Fauna and Flora.

Strict protection over the whole area of the Park.

Enclosures to which access should be forbidden all the year round or at breeding seasons, selected for the absolute unmolested protection of species deemed to require it. These would be absolute sanctuaries, but it is my own belief that in course of time, as the animals and the public educated each other, the species would spread from the sanctuaries to the general area.

I do not propose to frame a form of appendix to the general definition, as that could be done better by a small committee than in a public meeting, provided that we can reach general agreement as to what we want.

I note, in conclusion, that 'green belts' and land under the direction of the Forestry Commissioners certainly will add to the health and amenities of the general public and may lessen their requirements in National Parks, but, for the obvious reason that their primary purpose is not the preservation of wild life, cannot meet the wishes of naturalists.

Dr. JULIAN HUXLEY pointed out that a National Park must differ in its aims and functions in accordance with the country in which it was situated. While the definition quoted from the African Fauna Convention by Sir Peter Chalmers Mitchell was admirable for a continent like Africa, it was specifically adopted for the purposes of the Convention, and would not hold for a densely populated country like Great Britain. The Standing Committee on National Parks of the Councils for the Preservation of Rural England and Wales had recently published a pamphlet ('The Case for National Parks in

Great Britain') in which there was a definition of National Parks applicable to this country. This was as follows:— 'A National Park may be defined, in broad terms, as an extensive district of beautiful wilder landscape, strictly preserved in its natural aspect and kept or made widely accessible for public enjoyment and particularly cross-country walking, while continued in its traditional farming use. . . . It is an essential part of National Parks policy that, wherever practicable, strict Nature Reserves should be included in National Parks. . . . Moreover, a general protection of wild life by suitable management and by-laws should be applied throughout National Park areas.'

The same pamphlet also expressly pointed out what National Parks are *not*. Local or regional 'green belts' or open spaces are not National Parks, partly on account of their limited extent and partly because of their purely local value. Nature Reserves are not National Parks, though National Parks should include Sanctuaries or strict Nature Reserves, and should aim at the conservation of wild life throughout their area. National Forest Parks are not National Parks in the full sense, since their establishment involves considerable interference with the natural aspect of the country and with the free access of the public. Coastal preservation is a matter of national concern, but the coast-line can hardly be treated as a series of National Parks.

Following up these two apparently very different definitions we could arrive at a general definition along some such lines as these: (1) A National Park must be an extensive area, nationally dedicated, with boundaries that are unchangeable, except by legislative action. It must further consist in the main of more or less wild and unspoiled country, though there should be no insistence on the impossible and often undesirable ideal of its being in a 'state of nature'. (2) It should exist to promote the preservation of wild fauna and flora and, in certain cases, of features of geological interest. (3) It should exist to promote the access and healthy recreation of the general public.

Of these three aims, (1) appears to be universally applicable. Of the other two, in some cases (e.g. Africa) the first should be predominant, in other cases (e.g. England and Wales) the second. Where the preservation of wild life is the prime aim, the access of the public should still be allowed within reason; where public access and recreation is the prime aim, such fauna and flora as existed should always be protected, and in many cases a closed reserve or sanctuary should be established within the Park.

With reference to the particular question *a propos* of which this meeting had been called, of the National Park in South

Australia, this was really too small for a true National Park : but, as the title had been conferred, it should remain, provided that the claims of recreation did not override those of the preservation of unspoilt nature and of wild life. This could be accomplished if sports grounds and the like were confined to the margins of the Park, and did not take up more than at most a third of its total area. If more of the area were to be reclaimed from its unspoiled state, it would be better to change the title, so as not to prejudice the efforts of those who were striving for the establishment of true National Parks on a large scale.

Mr. JOHN DOWER (Visitor) said that he supported Dr. Huxley and agreed to his definition. The purpose of a National Park is to preserve the area in its natural setting. There is no possibility of an international definition. It is necessary to consider wildness, extensiveness, importance of natural features of landscape, fauna, and flora. He called attention to the pamphlet, 'The case for National Parks in Great Britain', published by the Standing Committee on National Parks.

Dr. G. F. HERBERT SMITH (Visitor) remarked that he was present as representative of the Society for the Promotion of Nature Reserves; together with Sir Peter Chalmers Mitchell and Professor E. J. Salisbury he had appeared before the Government Committee on National Parks and had drafted the evidence-in-chief; he was also a member of the National Parks Committee of the Council for the Preservation of Rural England. In his opinion the various definitions of national parks that had been published were in general harmony with one another, and it would now be best to adhere to the one included in the covenant in force for the preservation of the fauna and flora of Africa, the first international document in which the term appeared. He gave particulars of the position in the United States of America, the country with the longest and widest experience of such reservations. Provided that the area were large enough, it was perfectly feasible to use it for the triple purpose of recreation, the study of nature, and the protection of animals and plants; it was, however, essential that the nature sanctuary was controlled, since otherwise the very species that it was desired to preserve would be exterminated. It might be expected that a suitable area would be financially maintained from the fees payable for the use of playing fields, camping sites, and so on. The small park in question near Adelaide could probably be best treated by reserving a small nature sanctuary and by allocating the remainder to public enjoyment with the provision that parts of it in turn were closed for recuperation,

Professor F. E. WEISS said that as it was apparent from Prof. Osborn's description that this National Park of South Australia contained a considerable number of interesting and some rare plants, it was of primary importance that a sufficiently large portion of the area should be kept as a nature reserve. As there was both comparatively flat and also hilly land in the two square miles it would be well to include in the nature reserve both types with their respective plant communities, woodland, scrub grassland, so that the ecological conditions would be preserved and could here be studied. It would be well if this reserved area were provided with footpaths only, as motor roads would lead to a spoliation of the vegetation.

The area reserved for sports should be fenced off from the nature reserve to prevent encroachment upon the latter. The sports grounds should also be at the most easily reached end of the National Park.

Mr. C. A. GARDNER (Visitor) explained the way in which the term National Park is understood in Australia, and the importance of the Parks in relation to the preservation of the indigenous flora. Each State has its own, some definitely established for scenic reasons, others for the preservation of the native fauna and flora. Western Australia had five, which, with one exception, are Reservations of virgin country set aside for the purposes of the preservation of plants and animals. It would seem not unreasonable, moreover, that plants and animals from other areas within the State be introduced into these areas for preservation.

There is at present a tendency to make these Parks attractive to the general public by the provision of ornamental settings of exotic plants, flower-beds, swimming pools, and sports grounds, but preferably the only introductions of plants should be of those that are the rarer and more attractive from other parts of the same State. In this way an exhibit of these would be brought to the notice of people unable to travel to the remoter parts, and visitors would be enabled to view, close to the cities, such plants as are notable.

A National Park should serve as a sanctuary for those species which, as a result of agricultural extension, are in danger of extermination; and there were many species in Australia which, if not already extinct, are in danger of extinction from this cause.

Mr. I. H. BURKILL spoke to the point that small areas are difficult to maintain in their original state, saying that within his experience the block of thirteen acres of virgin jungle in the Botanic Gardens, Singapore, can only be retained as a 'Nature reserve' by interfering with its naturalness. A drier atmosphere had been produced by extensive drainage on all

sides, and the big trees give seed but no seedlings, so that replacement needs to be artificial.

Dr. W. T. CALMAN pointed out that a 'state of nature' was by no means a fixed and permanent thing, but a fluctuating and progressively changing condition. Nature reserves, especially when they were of small extent and in a long-settled country like Britain, could only be maintained in a 'wild' state by continual management and careful 'cultivation'. A highland grouse moor or deer forest, or even Wicken Fen itself, were as much the products of human interference as, and hardly less 'artificial' than, Kew Gardens or Whipsnade Park.

Replying, Professor OSBORN acknowledged that the area is too small for a National Park in the sense now used. But the name is unlikely to be changed, as it was given by Act of Parliament nearly fifty years ago. The difficulty confronting the Commissioners is how to reconcile their duty to maintain a place of recreation with a desire to conserve the fast disappearing wild plants and animal life of the Adelaide hills. In this they are strongly supported by the naturalists of South Australia. There is another and much larger 'National Park' at the western end of Kangaroo Island. It is Flinder's Chase, which is about 200 square miles in area. But the plant and animal life there differs from that of the Mount Lofty Ranges.

